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DOCUMENT CONTROL ADMINISTRATOR

Simpson

INSTRUMENTS THAT STAY ACCURATE

OPERATOR'S MANUAL

**VOLT-OHM-MILLIAMMETER
270 SERIES 4**

WARNING

For safe usage, it is essential that the operator read this manual carefully before using the instrument for any measurements.

SIMPSON ELECTRIC COMPANY

853 Dundee Ave., Elgin, Illinois 60120

Area Code 312, Telephone 697-2260

In Canada, Bach-Simpson, Ltd., London, Ontario

Warranty

SIMPSON ELECTRIC COMPANY warrants each instrument and other articles of equipment manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any instrument or other article of equipment which shall within 90 days after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service stations, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products.

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ELECTRICAL EQUIPMENT
GROUP

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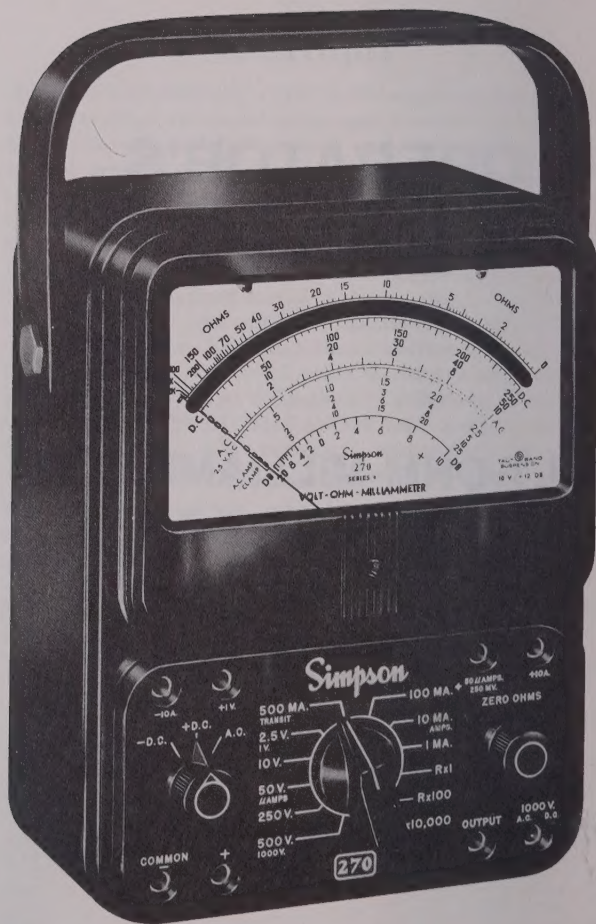


FIG. 1 270-4 VOLT OHM MILLIAMMETER

WARNING

This Instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely prior to making any measurements. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD: As defined in American National Standard, C39.5, Safety Requirements for Electrical & Electronic Measuring & Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts r.m.s. (sinewave) or 42.4 VDC or peak, and where a leakage current from that part to ground exceeds 0.5 milliampere, when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C39.5.

NOTE: The proper measuring instrument for the measurement of leakage current consists essentially of a network of a 1500 ohm non-inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229-Series 2 AC Leakage Current Tester meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC leakage current, connect a 1500 ohm non-inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.

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You have just purchased a Simpson 270-4. This instrument is a member of the world famous 260 family and is considered to be the standard VOM in many industries. In order to know the full capability of the instrument, read this manual carefully. See Page 3-1 for instructions on battery installation.

SECTION I

INTRODUCTION

GENERAL

The Simpson Volt—Ohm—Milliammeter 270 Series 4 is a rugged, accurate, compact, easy-to-use instrument. The instrument can be used to make accurate measurements of D.C. and A.C. voltage, direct current, resistance, decibels and "Output Voltage". It has a mirrored dial to eliminate parallax. The Output Voltage function is used for measuring the A.C. component of a mixture of A.C. and D.C. voltages. This occurs primarily in amplifier circuits.

The 270 Series 4 (hereafter also referred to as 270-4), has the following new features: a 0-1 volt D.C. range, 0-500 volt and A.C. ranges, a TRANSIT position on the range switch, rubber plug bumpers on the bottom of the case to reduce sliding, improved test leads and an externally accessible battery and fuse compartment. Batteries and fuse can be changed quickly by loosening the single screw of the compartment cover on the bottom of the case.

Higher accuracy is achieved by the use of .5% resistors. To complement the circuit accuracy, the 270 features the new Simpson taut-band, annular movement. The annular movement provides self-shielding. The taut-band suspension provides a high degree of repeatability and is highly resistant to damage by shock or vibration.

Several internally located calibration circuits are provided to increase the initial accuracy of the 270 and to facilitate recalibration should it become necessary.

Introduction

The 270 uses the most modern components and circuit techniques. It is assembled by well-trained personnel using quality materials and modern equipment. This combination of design, materials and skillful assembly results in a unit that will take considerable abuse and still provide accurate indication. If it is kept clean and is not unduly abused or misused, or subjected to extreme shock or vibration, the 270 will give many years of trouble-free service.

SPECIFICATIONS

RANGES

DC MILLIVOLTS

0-250 MV

Sensitivity: 20,000 ohms per volt

DC VOLTS

0-1-2.5-10-50-250-500-1000

Sensitivity: 20,000 ohms per volt

AC VOLTS

0-2.5-10-50-250-500-1000

Sensitivity: 5,000 ohms per volt

DC MICROAMPERES

0-50 250 MV Drop

DC MILLIAMPERES

0-1-10 250 MV Drop Approx.

0-100 280 MV Drop Approx.

0-500 400 MV Drop Approx.

DC AMPERES

0-10 250 MV Drop Approx.

OHMS

RX1	0-2,000	12 ohms center
RX100	0-200,000	1,200 ohms center
RX10,000	0-20 megohms	120,000 ohms center

Specifications

Range	Nominal Open Circuit Voltage	Nominal Short Circuit Current
RX1	1.5	125 MA
RX100	1.5	1.25 MA
RX10,000	9.0	75 μ AMPS

OUTPUT VOLTS (AC)

0-2.5-10-50-250

DECIBELS

With zero DB power level equal to 1 milliwatt across a
600 ohm line -20 to +10 DB
- 8 to +22 DB
+ 6 to +36 DB
+ 20 to +50 DB

BATTERIES

One 1.5 volt, NEDA 13F battery and one 9 volt, NEDA
1604 battery.

FUSE

1 ampere, 250 volts. Type 3AG. Quick Acting.

TEST LEADS

One red and one black test lead, each approximately
48 inches long. Two screw-on type alligator clips supplied.

SIZE

5-1/4" x 7" x 3-1/8"

WEIGHT

3 pounds

Specifications

ACCURACY

DC VOLTAGE

All ranges

77°F

67°–87°F

1.25% F.S.*

1.75% F.S.

AC VOLTAGE (See Note)

All ranges

2.0% F.S.

3.0% F.S.

DC CURRENT

0–50 microamperes

.75% F.S.

1.25% F.S.

Other ranges

1.25% F.S.

1.75% F.S.

RESISTANCE RANGES

R x 1 0–2000 Ω

1.5° of arc

1.75° of arc

R x 100 0–200,000 Ω

1° of arc

1.25° of arc

R x 10,000 0–20 megohms

1° of arc

1.25° of arc

FREQUENCY RESPONSE

Referenced to response at 100 Hz when making level measurements. See curves on pages 20 and 25.

*NOTE

Responds to the average value of an A.C. current and is calibrated to indicate the R.M.S. value of a pure sine wave.

*F.S. = Full Scale

Accuracies specified are for the 270 in a horizontal position.

GENERAL DESCRIPTION

ACCURACY

The 270-4 has the same physical configuration and ranges as the 260-6 but has higher accuracy. The higher accuracy is achieved by the use of .5% resistors combined with an instrument movement in which maximum precautions have been taken to minimize error.

The change in accuracy with a 10°F temperature change is $\pm 1/2\%$ of full scale on D.C. ranges and $\pm 1\%$ of full scale on A.C. ranges. These accuracy changes are linear over the temperature range of 67° to 87°F , being $\pm .05\%$ per $^{\circ}\text{F}$ on D.C. and $\pm .1\%$ per $^{\circ}\text{F}$ on A.C.

FRONT PANEL

The instrument has a large easy-to-read 4-1/2" indicating instrument at the top of the front panel. Below the indicating instrument are three operating controls and eight circuit jacks. All switch positions and circuit jacks are marked with white characters on black background to insure long-lasting, easy readability.

RANGE SWITCH

The range switch is located in the center of the lower part of the front panel and has 12 positions. It may be turned in either direction. There are five voltage positions, four direct current positions and three resistance positions.

General Description

FUNCTION SWITCH

The function switch is on the lower left of the front panel. It has three positions: -D.C., +D.C. and A.C. To measure current D.C. voltage or resistance, set the function switch at -D.C. or +D.C. according to the polarity of applied current or voltage. The function switch permits reversal of the test lead connections without removing the leads from the circuit under test.

ZERO OHMS

The control at the lower right on the panel is marked ZERO OHMS. It is a variable resistor in the ohmmeter circuit that compensates for variations in the voltage of the internal batteries.

CIRCUIT JACKS

There are eight jacks, two in each corner of the front panel. These are the connectors for the test leads. Plug the elbow prods of the test leads into the proper jacks to obtain the circuit and range desired for each application.

At the lower left are - COMMON and + jacks. Connect the black test to - COMMON for all circuits and ranges except 10 amperes D.C. Connect the red test lead to the + jack for all circuits and ranges except those designated by the other circuit jacks.

General Description

Across the top of the panel are jacks marked $-10A.$, $+1V.$, dual marking of $+50 \mu\text{AMPS}$ and $+250 \text{ MV}$ at a single jack and $+10A.$ For the 50 microampere or 250 millivolt D.C. range, connect the red test lead to this dual marked jack. For the 10 ampere D.C. range, use the black test lead in the $-10A.$ jack and the red test lead in the $+10A.$ jack.

At the lower right are OUTPUT and 1000 V. jacks. For all audio frequency output ranges, connect the red test lead to the OUTPUT jack. For 1000 volts A.C. or D.C., connect the red test lead to the 1000 V. jack.

PHENOLIC CASE

The phenolic case is designed with heavy reinforced walls for maximum durability and provides excellent protection for the circuit components.

The case has an externally accessible battery and fuse compartment. Access to the batteries and fuse is obtained by unscrewing a single captivated screw at the bottom of the case and sliding out the compartment cover. A spare fuse is also provided in the compartment.

Rubber plug bumpers on the bottom of the case reduce sliding should the 270 be accidentally pulled by the test leads when the instrument is on a workbench.

PRINTED CIRCUIT

Most of the component parts are mounted on a printed circuit board which simplifies assembly and maintenance, thus extending the useful life of the instrument.

ADJUST-A-VUE HANDLE

A carrying handle, attached to the sides of the instrument, may be used to attain a sloping position for easy viewing. The VOM case can also be placed in either a vertical or horizontal position. The horizontal position is preferable for greater accuracy since the instrument is calibrated in this position.

TEST LEADS

The instrument is furnished with a red and a black (polarity identification) test lead, each 4 feet long.

The insulation of the wire in the test leads is high-grade rubber and is more than adequate for the highest voltage that the instrument will measure. The red and black test leads have probe tips which are threaded near the base. Alligator clips may be screwed on or off either test lead to provide a probe or a clip for the operator's convenience.

TEST LEAD INSPECTION

Inspect the test leads frequently to detect cuts, burned areas or other damage that could reduce the insulation strength. When replacement is needed, order catalog number 00115 from your local parts distributor.

FUSE PROTECTION

A 1 ampere 250 V. fuse is provided to protect the circuits on the ohmmeter ranges and from excessive overloads on the milliamperere ranges. If instrument fails to indicate, the fuse

General Description

may be burned out. See Section III, MAINTENANCE, for fuse replacement. A spare is also located in the battery and fuse compartment.

MOVEMENT OVERLOAD PROTECTION

In addition to the fuse, a varistor protects the indicating instrument circuit. The varistor limits the current through the moving coil in case of overload.

The fuse and varistor will prevent serious damage to the 270 in most cases of accidental overload. However, no overload protection system is completely foolproof and misapplication on high voltage circuits can damage the instrument. Care and caution should always be exercised to protect both you and your VOM.

INTERNAL BATTERIES

There are two batteries in the ohmmeter circuits. One is a 1.5 volt cell NEDA 13F D size (for the R x 1 and R x 100 ranges). A NEDA 1604 battery furnishes 9 volts for the R x 10,000 range. The 1.5 volt D cell is held in place with two spring clips which also serve as battery contacts.

The polarity symbols for the D cell are marked near the battery contacts. The 9 volt battery is held in place with a spring clip but contact is made with a separate connector that is polarized. Always observe correct polarity when replacing the 1.5 volt D cell.

SECTION II

OPERATING INSTRUCTIONS

GENERAL

WARNING

The Simpson 270-4 is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely prior to making any measurements. Failure to do so can result in a serious or fatal accident.

This section of the manual contains all the information related to operation of the Instrument. Special notes and instructions have been included for added safety and convenience.

SAFETY PRECAUTIONS

The Model 270-4 Volt-Ohm-Milliammeter should only be used by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury. Refer to "SHOCK HAZARD" definition on page iii.

- a. Do not work alone when making measurements of circuits where a shock hazard can exist. Notify another person that you are, or intend to make such measurements.
- b. Locate all voltage sources and accessible paths prior to making measurement connections. Check that the equipment is properly grounded and the right rating and type of fuse(s) is installed. Set the Instrument to the proper range before power is applied.

Operating Instructions

c. Remember, voltages may appear unexpectedly in defective equipment. An open bleeder resistor may result in a capacitor retaining a dangerous charge. Turn off power and discharge all capacitors before connecting or disconnecting test leads to and from the circuit being measured.

d. For your own safety, inspect the test leads for cracks, breaks or crazes in the insulation, prods and connectors before each use. If any defects exist, replace the test leads immediately.

e. Do not make measurements in a circuit where corona is present. Corona can be identified by a pale-blue color emanation from sharp metal points in the circuit, the odor of ozone and its sound.

f. Hands, shoes, floor and workbench must be dry. Avoid making measurements under humid, damp, or other environmental conditions that could affect the dielectric withstanding voltage of the test leads or Instrument.

g. For maximum safety, do not touch test leads, or Instrument while power is applied to the circuit being measured.

h. Use extreme caution when making measurements in an RF circuit where a dangerous combination of voltages could be present, such as in a modulated RF amplifier.

Operating Instructions

- i. Do not make measurements using test leads which differ from those originally furnished with the Instrument.
- j. Do not come into contact with any object which could provide a current path to the common side of the circuit under test or power line ground. Always stand on a dry insulating surface capable of withstanding the voltage being measured, or that could be encountered.
- k. The range or function switch should only be changed when the power to the circuit under measurement is turned off. This will provide maximum safety to the user, eliminate arcing the switch contacts and prolong the life of the 270-4.

UNPACKING

After unpacking the 270 you will find the 1.5 volt and 9 volt batteries in a polyethylene bag inside the box with the instrument and test leads. Two alligator clips for the test leads are in another polyethylene bag. See Section III, MAINTENANCE, for instructions on how to open the battery compartment and install the batteries.

ADJUST POINTER FOR ZERO

With the volt-ohm-milliammeter in operating position, check that the pointer indicates zero at the left side of the scale when there is no input to the 270. If pointer is off zero, adjust the screw located in the case below center of the dial. Use a small screwdriver to turn the screw slowly clockwise

Operating Instructions

or counterclockwise until the pointer is exactly over the zero mark at the left side of the scale. With the indicating pointer set on the zero mark, reverse the direction of rotation of the zero adjuster. Rotate the zero adjuster a sufficient amount to introduce mechanical freedom or "play" but insufficient to disturb the position of the indicating pointer. This procedure will eliminate disturbances to the zero setting from subsequent changes in temperature, humidity, vibration and other environmental conditions.

POLARITY CORRECTION

When making D.C. measurements with the test leads connected to the + and - COMMON jacks, polarity can be reversed with the function switch without reversing the test leads. When making measurements on the +50 μ AMPS/250 MV range, 1 volt D.C. range or 10 A range, polarity can be corrected only by reversing the test leads.

DEFINITION OF ACCURACY

The voltage and current accuracy of this instrument is commonly expressed as a percent of full scale. This should not be confused with accuracy of reading (indication). For example, $\pm 2\%$ of full scale on the 10 volt range allows an error of +0.20V at any point on the dial. This means that at full scale the accuracy of reading would be $\pm 2\%$, but at half scale it would be $\pm 4\%$. Therefore, it is advantageous to select a range which gives an indication as near as possible to full scale.

Operating Instructions

D.C. VOLTAGE MEASUREMENTS

MEASURING D.C. VOLTAGE

0–250 MILLIVOLTS



CAUTION

When using the 270-4 as a millivoltmeter, care must be taken to prevent damage to the indicating instrument from excessive voltage. Before using the 250 millivolt range, first use the 1.0 volt D.C. range to determine that the voltage measured is no greater than 250 millivolts (or .25 volt D.C.).

1. Set the function switch at +D.C.
2. Plug the black test lead in the –COMMON jack and the red test lead in the +50 μ AMPS/250 MV jack.
3. Set the range switch at 50 μ AMPS (dual position with 50 V.).
4. Connect the black test lead to the negative side of the circuit being measured and the red test lead to the positive side of the circuit.
5. Read the voltage on the black scale marked D.C. and use the figures marked 0-250. Read directly in millivolts.

Operating Instructions

MEASURING D.C. VOLTAGE

0—1 VOLT

1. Set the function switch at +D.C.
2. Plug the black test lead in the —COMMON jack and the red test lead in the +1 V. jack.
3. Set the range switch at 1 V. (dual position with 2.5 V.).
4. Connect the black test lead to the negative side of the circuit being measured and the red test lead to the positive side of the circuit.
5. Read the voltage on the black scale marked D.C. Use the figures marked 0-10 and divide the reading by 10.

MEASURING D.C. VOLTAGE

0-2.5 THROUGH 0-500 VOLTS

1. Set the function switch on the left side of the front panel at +D.C.
2. Plug the black test lead in the —COMMON jack and the red test lead in the + jack.

Operating Instructions

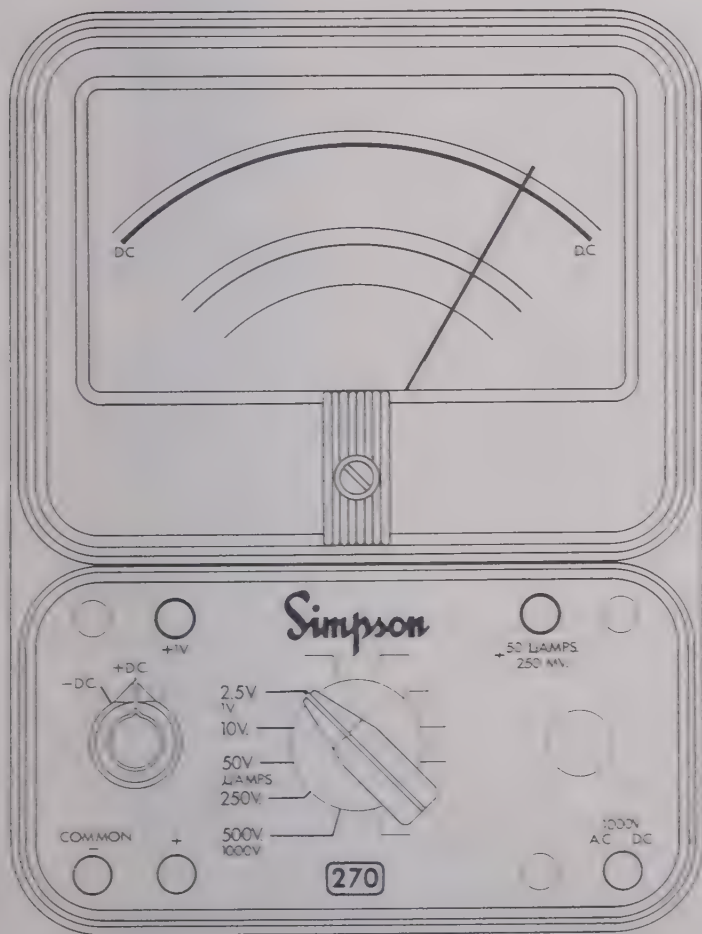


FIG. 2 JACKS AND SWITCH POSITIONS FOR MEASURING D.C. VOLTAGE

Operating Instructions

3. Set the range switch at one of the five voltage range positions marked 2.5 V., 10 V., 50 V., 250 V. or 500 V. When in doubt as to the voltage present, always use the highest voltage range as a protection to the instrument. If the voltage is within a lower range, the switch may be set for the lower range to obtain a more accurate reading.
4. Connect the black test lead to the negative side of the circuit being measured and the red test lead to the positive side of the circuit.
5. Read the voltage on the black scale marked D.C. For the 2.5 V. range, use the 0-250 figures and divide by 100. For the 10 V., 50 V., and 250 V. ranges, read the figures directly. For the 500 V. range, use the 0-50 figures and multiply by 10.

MEASURING D.C. VOLTAGE 0—1000 VOLTS

WARNING

Be extremely careful when working with high voltage circuits. Do not touch the instrument test leads while power is on in the circuit being measured.

1. Set the function switch at +D.C.
2. Set the range switch at 1000 V.
(dual position with 500 V.).

Operating Instructions

3. Plug the black test lead in the —COMMON jack and the red test lead in the 1000 V. jack.
4. Be sure power is off in the circuit being measured and all capacitors have been discharged. Connect the black test lead to the negative side of the circuit being measured and the red test lead to the positive side of the circuit.
5. Turn on the power in the circuit being measured.
6. Read the voltage using the 0-10 figures on the black scale marked D.C. Multiply the reading by 100.

NOTE: To measure higher D.C. voltage, see Section IV, ACCESSORIES, for higher voltage accessory probes.

A.C. VOLTAGE MEASUREMENTS

MEASURING A.C. VOLTAGE

(See **CAUTION** note under **OPERATING INSTRUCTIONS**)

0--2.5 THROUGH 0--500 VOLTS

CAUTION

When measuring line voltage such as from a 120 volt, 240 volt or 480 volt source, be sure that the range switch is set to the proper voltage position.

Operating Instructions

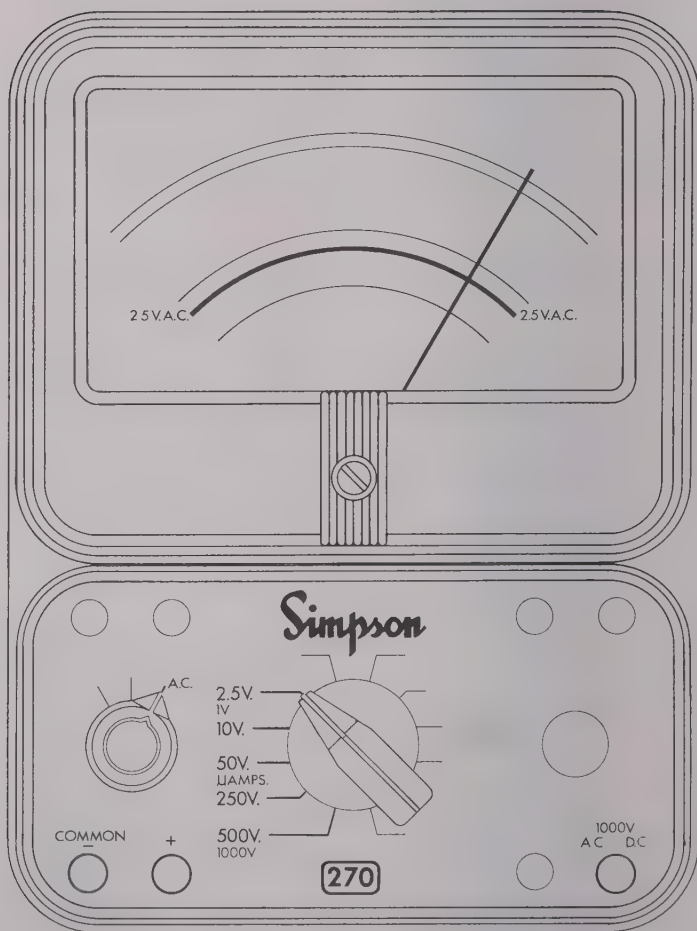


FIG. 3 JACKS AND SWITCH POSITIONS FOR MEASURING A.C. VOLTAGE

Operating Instructions

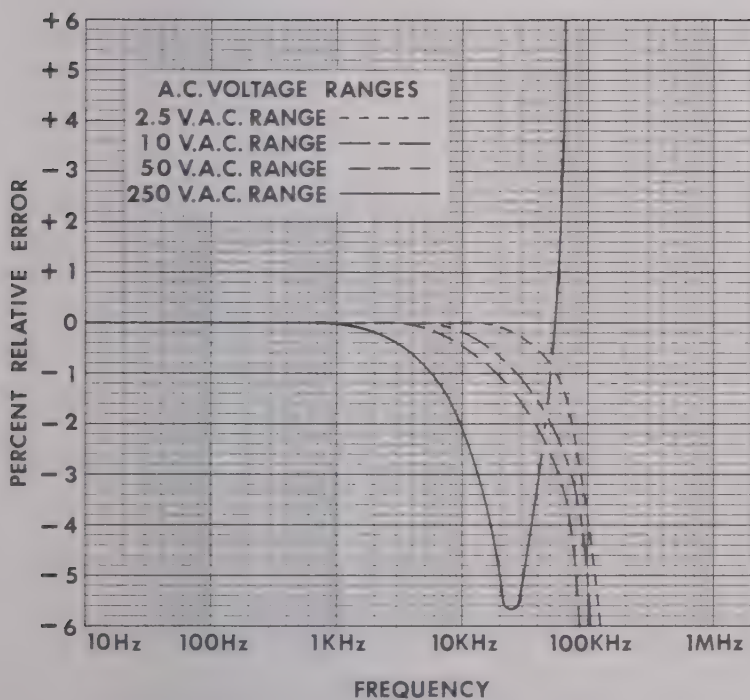


FIG. 4 FREQUENCY RESPONSE A.C. VOLTAGE RANGES

Operating Instructions

The Simpson 270-4 responds to the average value of an AC waveform. It is calibrated in terms of the RMS value of a pure sine wave. If the waveform is nonsinusoidal, and depending upon its waveform, the reading may be either higher or lower than the true RMS value of the measured voltage. Thus an error may be introduced if the 270-4 is used to measure a nonsinusoidal waveform.

1. Set the function switch at AC.
2. Set the range switch at one of the five voltage range positions marked 2.5 V., 10 V., 50 V., 250 V. or 500 V. When in doubt as to the actual voltage present, always use the highest voltage range as a protection to the instrument. If the voltage is within a lower range, the switch may be set for the lower range to obtain a more accurate reading.
3. Plug the black test lead in the —COMMON jack and the red test lead in the +jack.
4. Connect the test leads across the voltage source.
5. Turn on power in the circuit being measured.
6. For the 0-2.5 V. range, read the value directly on the scale marked 2.5 VAC. For the 10 V., 50 V., and 250 V. ranges, read the red scale marked AC and use the black figures immediately above the scale. For the 500 V. range, read the red scale marked AC and use the 0-50 figures. Multiply the reading by 10.

Operating Instructions

MEASURING THE A.C. VOLTAGE

0--1000 VOLTS

WARNING

Be extremely careful when working in high voltage circuits. Do not touch the instrument or test leads while power is on in the circuit being measured.

1. Set the function switch at AC.
2. Set the range switch at 1000 V. (dual position with 500 V.).
3. Plug the black test lead in the —COMMON jack and the red test lead in the 1000 V. jack.
4. Be sure the power is off in the circuit being measured and that all its capacitors have been discharged. Connect the test leads to the circuit.
5. Turn on the power in the circuit being measured.
6. Read the voltage on the red scale marked AC. Use the 0-10 figures and multiply by 100.

OUTPUT VOLTAGE AND DECIBEL MEASUREMENTS

MEASURING OUTPUT VOLTAGE

It is often desired to measure the AC component of an Output Voltage where both AC and DC voltage levels exist. This occurs primarily in amplifier circuits.

Operating Instructions

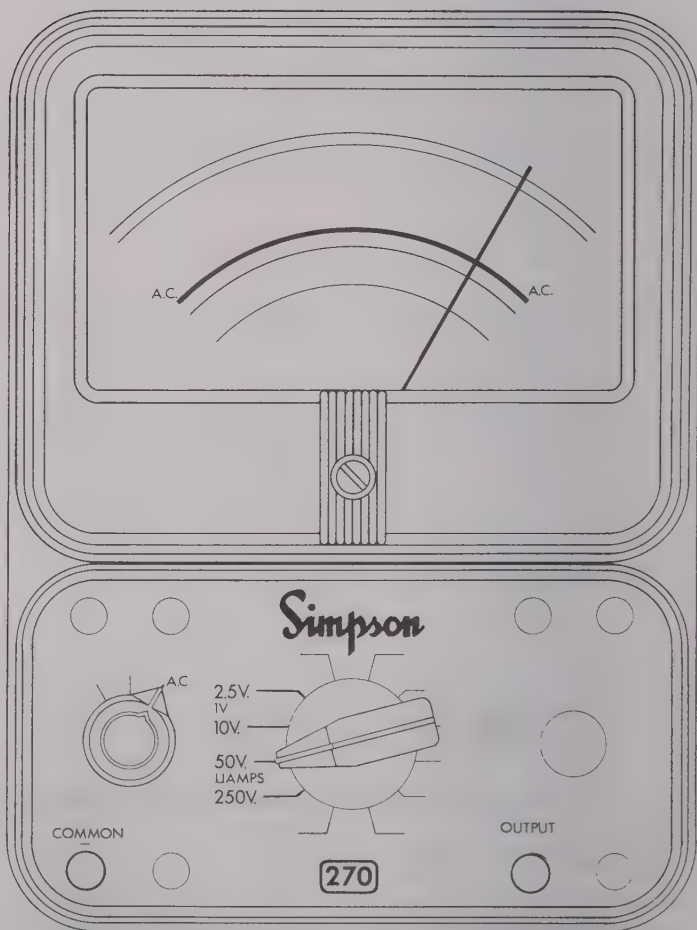


FIG. 5 JACKS AND SWITCH POSITIONS FOR MEASURING OUTPUT

Operating Instructions

The 270-4 has a .1 mfd, 400 volt capacitor in series with the OUTPUT jack. The capacitor blocks the DC component of the current in the test circuit, but allows the AC or desired component to pass on to the indicating instrument circuit. The blocking capacitor may alter the AC response at low frequencies but is usually ignored at audio frequencies.

CAUTION

When using OUTPUT, do not apply to a circuit whose DC voltage component exceeds the 400 volt rating of the blocking capacitor.

1. Set the function switch at AC.
2. Plug the black test lead in the -COMMON jack and the red test lead in the OUTPUT jack.
3. Set the range switch at one of the range positions marked 2.5 V., 10 V., 50 V. or 250 V.
4. Connect the test leads across the circuit being measured with the black test lead to the ground side.
5. Turn on the power in the test circuit. Read the output voltage on the appropriate AC voltage scale. For the 0-2.5 V. range, read the value directly on the scale marked 2.5 VAC. For the 10 V., 50 V., or 250 V. ranges, use the red scale marked AC and read the black figures immediately above the scale.

Operating Instructions

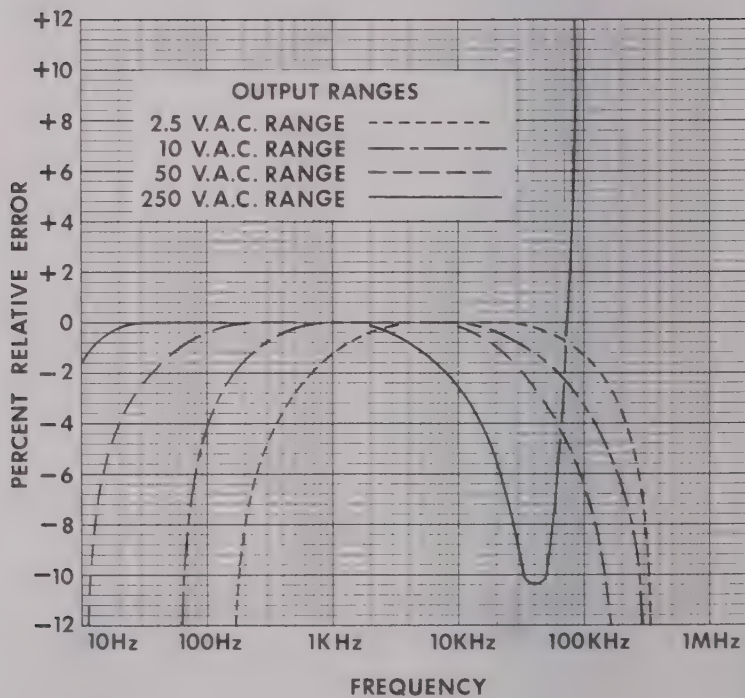


FIG. 6 FREQUENCY RESPONSE OUTPUT RANGES

MEASURING DECIBELS

For some applications, output voltage and audio frequency voltage are frequently measured in terms of decibels. The decibel scale (DB) at the bottom of the dial is marked from -20 to $+10$.

To measure decibels, read the DB scale in accordance with instructions for measuring AC. For example, when the range switch is set on the 2.5 V position, the DB scale is read directly.

The DB readings on the scale are referenced to zero DB power level of .001 watt in 600 ohms, or .775 VAC across 600 ohms.

For the 10 V. range, read the DB scale and add $+12$ DB to the reading. For the 50 V. range, read the DB scale and add $+26$ DB to the reading. For the 250 V range, read the DB scale and add $+40$ DB to the reading.

If the zero DB reference level is .006 watt in 500 ohms, subtract 7 DB from the reading.

Operating Instructions

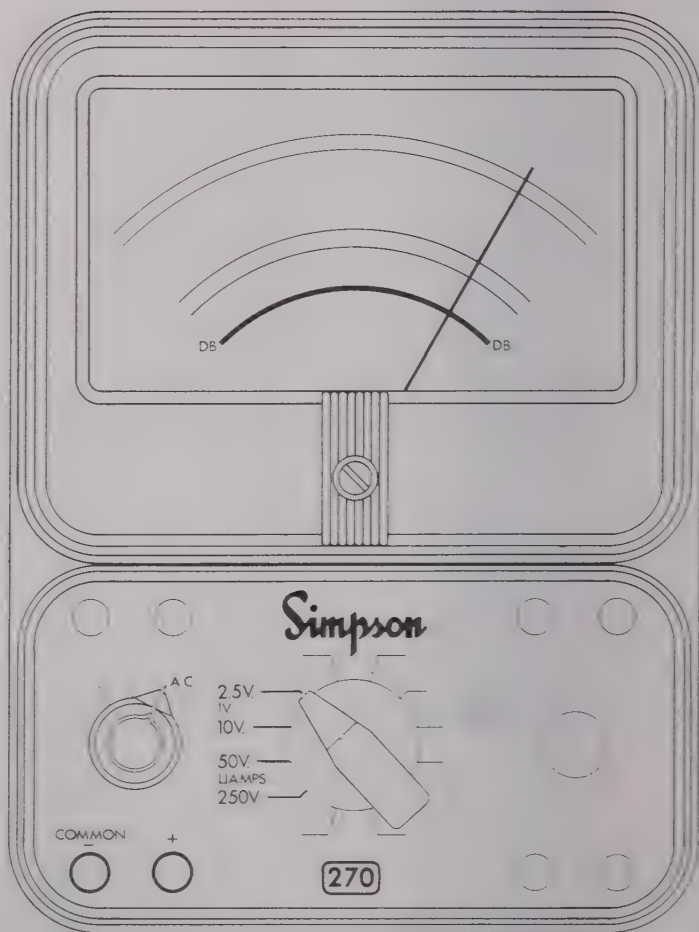


FIG. 7 JACKS AND SWITCH POSITIONS FOR MEASURING DECIBELS

Operating Instructions

DIRECT CURRENT MEASUREMENTS

(See **CAUTION** note under **OPERATING INSTRUCTIONS**)

VOLTAGE DROP

The voltage drop across the 270 on all milliamperere current ranges is approximately 250 millivolts measured at the jacks. An exception is the 0-500 MA range with a drop of approximately 400 millivolts. The voltage drop will not affect most circuits whose current is being measured. In some transistor circuits, it may be necessary to compensate for the added voltage drop when making measurements.

MEASURING DIRECT CURRENT

0-50 MICROAMPERES

CAUTION

Never connect the test leads directly across voltage when the 270 is used as a current indicating instrument. Always connect the instrument in series with the load across the voltage source.

1. Set the function switch at +D.C.
2. Plug the black test lead in the -COMMON jack and the red test lead in the +50 μ AMPS/250 MV jack.
3. Set the range switch at 50 μ AMPS (dual position with 50 V.).

Operating Instructions

4. Open the circuit in which the current is being measured. Connect the instrument in series with the circuit. Connect the red test lead at the positive side and the black test lead at the negative side.
5. Read the current on the black D.C. scale. Use the 0–50 figures to read directly in microamperes.

NOTE: In all direct current measurements, be certain the power to the circuit being tested has been turned off before disconnecting test leads and restoring circuit continuity.

The internal voltage drop of the 270 on the 50 microampere range is 250 millivolts. The 50 microampere range serves as a dual function. Either 50 microamperes D.C. or 250 millivolts D.C. can be measured at this single jack position.

MEASURING DIRECT CURRENT

0–1 THROUGH 0–500 MILLIAMPERES

1. Set the function switch at +D.C.
2. Plug the black test lead in the –COMMON jack and the red test lead in the $\star$ jack.
3. Set the range switch at one of the four range positions marked 1 MA., 10 MA., 100 MA., or 500 MA.
4. Open the circuit in which the current is being measured. Connect the VOM in series with the circuit. Connect the red test lead to the positive side and the black test lead to the negative side.

Operating Instructions

5. Read the current in milliamperes on the black D.C. scale. For the 1 MA. range, use the 0–10 figures and divide by 10. For the 10 MA. range use the 0–10 figures and multiply by 10. For 500 MA. range, use the 0–50 figures and multiply by 10.

MEASURING DIRECT CURRENT

0–10 AMPERES

1. Plug the black test lead in the –10 A. jack and the red test lead in the +10 A. jack.
2. Set the range switch at 10 AMPS (dual position with 10 MA.).
3. Open the circuit in which the current is being measured. Connect the instrument in series with the circuit. Connect the red test lead at the positive side and the black test lead at the negative side.

NOTE: The function switch has no effect on polarity for the 10 AMPS range.

4. Read the current on the black D.C. scale. Use the 0–10 figures to read directly in amperes.

CAUTION

When using the 10 ampere range, never remove a test lead from its panel jack while current is flowing through the circuit. Otherwise damage may occur to the banana plug and jack.

Operating Instructions

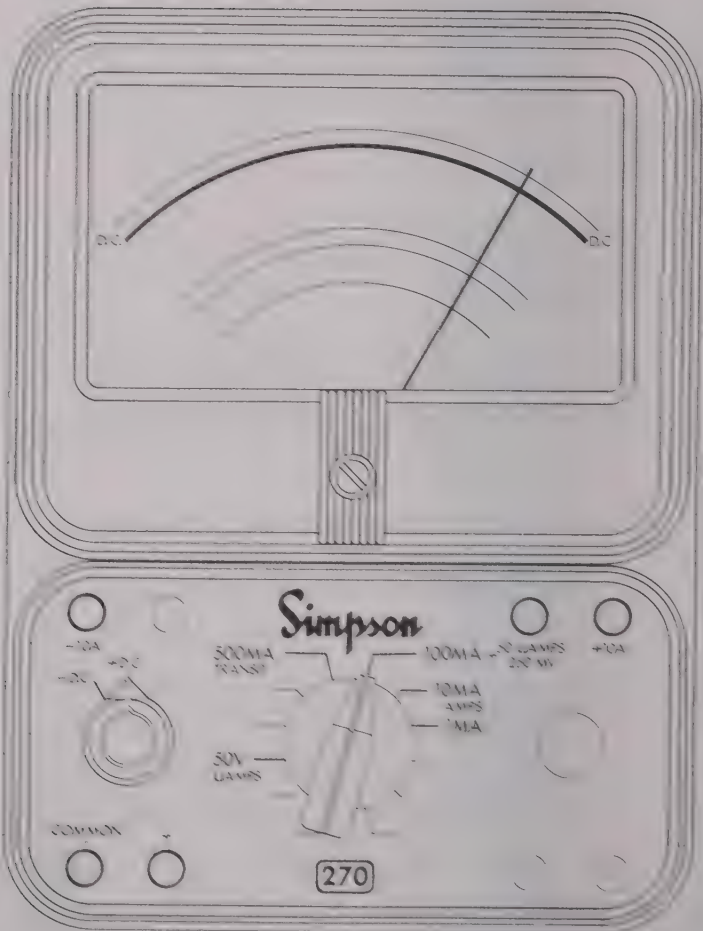


FIG 8 JACKS AND SWITCH POSITIONS FOR MEASURING DIRECT CURRENT

Operating Instructions

TRANSIT

The 500 MA. range switch position is also the TRANSIT position. The additional damping of the movement in the TRANSIT position will reduce pointer swing when the 270 is carried.

RESISTANCE MEASUREMENTS

ZERO OHMS ADJUSTMENT

When resistance is measured, VOM batteries B1 and B2 furnish power for the circuit. Since batteries are subject to variation in voltage and internal resistance, the instrument must be adjusted to zero prior to measuring a resistance, as follows:

1. Turn range switch to desired ohms range.
2. Plug the black test lead in the -COMMON jack and the red test lead in the + jack.
3. Connect ends of test leads to short the VOM resistance circuit.
4. Rotate the ZERO OHMS control until pointer indicates zero ohms. If pointer cannot be adjusted to zero, one or both of the batteries must be replaced. For battery replacement, see Section III, MAINTENANCE.
5. Disconnect ends of test leads and connect to component being measured.

Operating Instructions

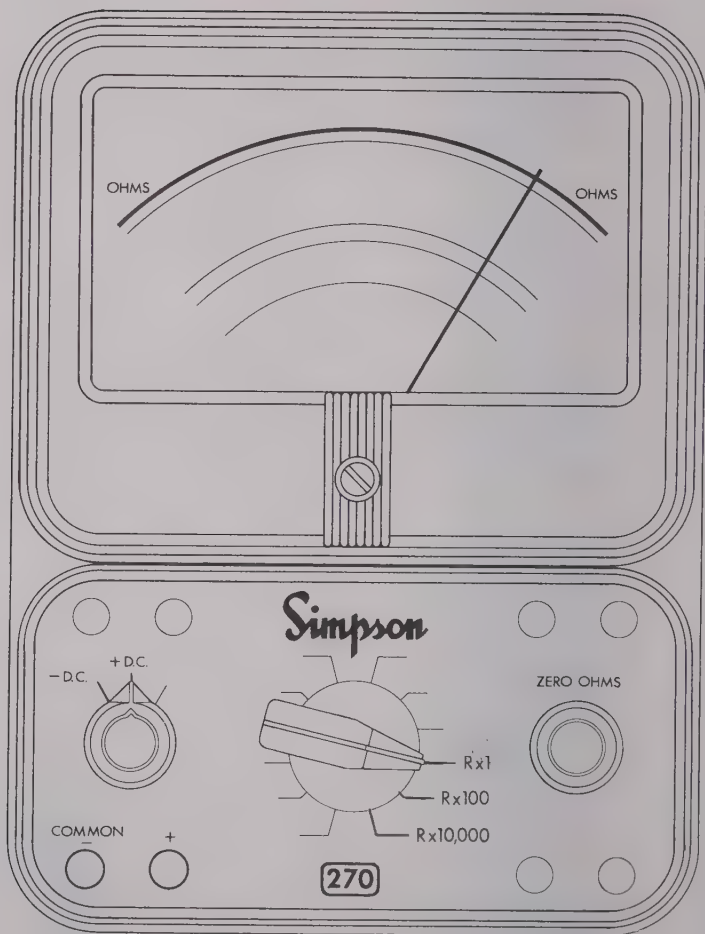


FIG. 9 JACKS AND SWITCH POSITIONS FOR MEASURING RESISTANCE

Operating Instructions

MEASURING RESISTANCE

CAUTION

Before measuring resistance, be sure power is off to the circuit being tested. Disconnect the component from the circuit before measuring its resistance.

Set the range switch to one of the resistance range positions as follows:

1. Use $R \times 1$ for resistance readings from 0 to 200 ohms.
2. Use $R \times 100$ for resistance readings from 200 to 20,000 ohms.
3. Use $R \times 10,000$ for resistance readings above 20,000 ohms.

Set the function switch at either - DC or + DC position. Operation is the same in either position.

Adjust ZERO OHMS control for each resistance range.

4. Observe the reading on the OHMS scale at the top of the dial. Note that the OHMS scale reads from right to left for increasing values of resistance.
5. To determine the actual resistance value, multiply the reading by the factor at the switch position (K on the OHMS scale equals one thousand).

If there is a "forward" and "backward" resistance such as in diodes, the resistance should be relatively low in one direction (for forward polarity) and higher in the opposite direction.

Check that the OHMS range being used will not damage any of the semiconductors.

If the purpose of the resistance measurement is to check a semiconductor in or out of a circuit (forward and reverse bias resistance measurements), consider the following, prior to making the measurement:

- a. The polarity of the voltage at the input jacks is identical to the input jack markings. Therefore, be certain that the polarity of the test leads is correct for application.
- b. Insure that the range selected will not damage the semiconductor. Refer to Specifications in Section I, and review the specification limits of the semiconductor according to the manufacturer's ratings.

(1) If the semiconductor is a silicon diode or conventional silicon transistor, no precautions are normally required.

(2) If the semiconductor material is germanium check the ratings of the device and refer to Specifications, Section I.

Rotate the function switch between the two D.C. positions to reverse polarity. This will determine if there is a difference between the resistance in the two directions.

The resistance of such diodes will measure differently from one resistance range to another on the same VOM with the function switch in a given position. For example, a diode which measures 80 ohms on the R x 1 range may measure 300 ohms on the R x 100 range. The difference in values is a result of the diode characteristic and does not indicate any fault in the VOM.

SECTION III

MAINTENANCE

BATTERY REPLACEMENT

Two batteries are used inside the case to supply power for resistance measurements. One is a 1.5 volt D cell and the other is a 9 volt battery. When it is no longer possible to adjust the pointer to zero for the $R \times 1$ and $R \times 100$ ranges (see ZERO OHMS ADJUSTMENT on page 2-23, replace the 1.5 volt cell. When it is no longer possible to adjust the pointer to zero on the $R \times 10,000$ range, replace the 9 volt battery.

Recommended replacement batteries are:

1.5 volt cell, NEDA 13F (Burgess No. 2 or Eveready No. 950).

9 volt battery, NEDA 1604 (Burgess 2U6 or Eveready 216).

To install or replace a battery, remove the cover to the externally accessible battery compartment by loosening the single captivated screw. A small coin may be used to loosen the screw.

NOTE: When the batteries reach the end of their useful life, they should be replaced promptly. Failure to do so may result in corrosion at the battery contacts due to battery leakage.

Maintenance

Observe polarity when replacing the 1.5 volt D cell and connect as indicated. The D cell is held in place with spring clips which also act as battery contacts. Polarity for the D cell is marked adjacent to the battery contact clips. The 9 volt battery contacts and connector are polarized. To remove the 9 volt battery, first withdraw the battery with mated connector from the compartment. Then disconnect the connector.

FUSE REPLACEMENT

The fuse is mounted in a holder in the externally accessible battery and fuse compartment. A spare fuse is located in a well between the + terminal of the D cell and the side of the case. Access to the compartment is obtained by loosening the single captivated screw on the compartment cover. To replace a burned out fuse, remove it from the holder and replace it only with a 1 ampere, 250 volt, quick acting type 3 AG fuse or equivalent. When removing the fuse from its holder, first remove the 9 volt battery.

CARE

Your 270-4 VOM is a very fine instrument. It has been designed to give many years of service. Give it good care and help to prolong its life by observing the following practice:

1. Keep the instrument in a horizontal position when storing and away from the edge of a workbench, shelf or other areas where it may be knocked off and damaged.

Maintenance

2. Avoid rapid or extreme temperature changes.
3. Avoid overloading the measuring circuits of the instrument. Develop a habit of checking the range position before connecting the test leads to a circuit.
4. Place the range switch in the TRANSIT position when the instrument is not in use or when being moved. The indicating instrument is damped in the TRANSIT position to reduce swinging of the pointer when the 270 is carried.
5. If the 270 has not been used for a long period of time, rotate the function and range switches in both directions to wipe the switch contacts for good electrical contact.
6. The instrument may be protected by one of three carrying cases. These can be obtained through your local electronic parts distributor.

PART NO.	DESCRIPTION
00549	Utility Vinyl Case
01818	Leather Case
00805	Ever-Ready Leather Case

HOW TO OPEN THE CASE

To gain access to the inside of the case for replacement of parts, remove the four screws in the bottom of the case. Two of the screws can be reached only by first removing the cover from the battery compartment. After removing the screws lift the case from the panel. When replacing the case, be certain that the wires leading to the battery compartment are seated in their respective slots in the compartment wall. This will prevent damage to the wire insulation during mating of panel and case.

MAINTENANCE

PARTS LIST

Reference Symbol	Description	Simpson Part No.
R-1	Rheostat, 200K Ohms	1-110193
R-2	Rheostat, 5K Ohms	5-112917
R-3	Resistor, 15K Ohms	5-115082
R-4	Resistor, 45K Ohms	1-117148
R-5	Resistor, 150K Ohms	1-117149
R-6	Resistor, 800K Ohms	1-117147
R-7	Resistor, 4 megohms	1-117151
R-8	Resistor, 5 megohms	1-118181
R-9	Resistor, 7.5 megohms	5-115081
R-10	Resistor, 2.5 megohms	5-115080
R-11	Resistor, 0.025 Ohm Shunt 10A. (Calibrate in VOM)	3-811793
R-12	Resistor, 0.468 Ohm (Bobbin)	10-675254
R-13	Resistor, 2 Ohms (Bobbin)	10-805077
R-14	Resistor, 22.5 Ohms (Bobbin)	10-805076
R-15	Resistor, 238 Ohms	5-115079
R-16	Resistor, 11.2 Ohms (Bobbin)	10-805073
R-17	Resistor, 1.109K Ohms	5-115083
R-18	Resistor, 123.57 Ohms	5-115086
R-19	Resistor, 17.55K Ohms	5-115084
R-20	Resistor, 113.77K Ohms	5-115085
R-21	Potentiometer, 11.25K Ohms	5-115263
R-22	Rheostat, 5K Ohms	1-116254
R-23	Resistor, 4K Ohms	1-117140
R-24	Resistor, 4K Ohms	1-117140
R-25	Rheostat, 5K Ohms	1-116254

Maintenance

Reference Symbol	Description	Simpson Part No.
R-26	Resistor, 7.5K Ohms	1-117152
R-27	Resistor, 37.5K Ohms	1-117145
R-28	Resistor, 200K Ohms	1-117146
R-29	Resistor, 1 megohm	1-117150
R-30	Resistor, 1.25 megohms	5-110455
C-1	Capacitor, .1 uF, 400 V.	1-113733
D-1	Diode, Germanium	1-110722
D-2	Diode, Germanium	1-110722
V-1	Varistor, Silicon	1-110670
F-1	Fuse, 1 Amp, 250 V. 3 AG (1-1/4" x 1/4") Quick Acting	1-112507

Knobs:

For Function Switch	1-115789
For Zero Ohms Adjust	1-115790
For Range Switch (less set screw) (less Set Screw)	3-260180
Set Screw (For Knob 3-260180)	1-114178

PARTS LIST

Description	Simpson Part No.
Case Assembly, Phenolic, Complete, (including handle less Battery Compartment Cover)	10-861725
Battery Compartment Cover Assembly for case	10-861724
Carrying Handle for case	10-860158
Rubber Bumper Plug	5-115039
270-4 Indicating Instrument with Panel Assembly	D-13823
Cover Assembly for Indicating Instrument	0-005674
Combination Probe Tip Leads, one red and one black, with removable alligator clips	00115
Crocodile Clip Test Leads, one red and one black	07500

SECTION IV

ACCESSORIES

D.C. HIGH VOLTAGE PROBES (20,000 ohms per volt)

10,000 volts D.C.....	No. 00507
25,000 volts D.C.....	No. 00508
30,000 volts D.C.....	No. 00509

GENERAL DESCRIPTION

The D.C. high voltage probes extend the range of a 20,000 ohms per volt multimeter in a safe, convenient manner at nominal cost. Their primary purpose is the measurement of terminal potential of high voltage, low power, direct current sources. Examples are anode supplied in television receivers and other cathode ray tube circuitry.

CAUTION

Do not use on electrical equipment that can deliver high power under short-circuit conditions such as from a large D.C. motor-generator set.

The probe body is made of high temperature polystyrene to provide high dielectric strength and low leakage. It contains a high megohm precision resistor.

A shielded cable and internal probe shield protect the operator from any flash-over and to ground any electrostatic charge that might accumulate on the probe body.

The shielded cable and internal probe shield are connected to the ground return lead by a flexible copper braid between the two elbow connectors. A ground return lead 48 inches long with an insulated clip completes the test lead set. No additional wires are needed.

ELECTRICAL SPECIFICATIONS

The D.C. high voltage probes are designed for use with the Simpson 270 Series 4 or any 20,000 ohms per volt VOM having a 2.5 volt D.C. range and scale graduations from 0-10 or multiple thereof for the 10 KV probe, 0-25 or multiple thereof for the 25 KV probe and 0-50 or multiple thereof for the 30 KV probe.

Accuracy:

Probe Resistance $\pm 2\%$

The D.C. high voltage test probes are available at your local electronic parts distributor. Instructions are furnished with each high voltage probe.

A.C. HIGH VOLTAGE PROBE (5,000 ohms per volt)

10,000 volts A.C. No. 00161

GENERAL DESCRIPTION AND ELECTRICAL SPECIFICATIONS

The 10,000 volts A.C. probe is similar to the high voltage D.C. probes with the following exceptions: The A.C. high voltage probe is designed primarily to extend the range of a 5,000 ohms per volt V.O.M. The probe is used with the instrument in the 10 volt A.C. position. Read the 0-10 volt A.C. scale and multiply by 1000.

CAUTION: Do not use on electrical equipment that can deliver high power under short-circuit conditions such as from a power distribution transformer.

AMP--CLAMP MODEL 150

The Simpson Amp-Clamp Model 150 allows A.C. current measurements without breaking the circuit under test. The Amp--Clamp works in effect as a transformer containing a split core for accommodating the conductor which carries the current being measured.

The current carrying conductor becomes the transformer primary and a coil in the Amp--Clamp serves as the secondary winding. The Amp--Clamp output voltage is proportional to the current measured and can be applied to the 270 as an A.C. voltage.

The Amp--Clamp has a range selector with 6 positions. Any of the following current ranges can be used with the 270:

5, 10, 25, 100 or 250 amperes.

1. Set the function switch of the 270 to A.C. and the range switch to 2.5 V.
2. Set the current range selector on the Amp--Clamp to a range which covers the probable current being measured.
3. Connect the Amp Clamp leads to the --COMMON and + jacks of the 270.
4. Open the jaws of the Amp--Clamp and place around the conductor whose current is to be measured.
5. The current being measured can easily be read from the green Amp--Clamp scale on the 270 meter face. The 5, 10 and 25 amp scale is read directly from the 270. The 100 and 250 amp range is read on the 10 or 25 respectively, then multiplied by 10 to give the correct AC current being measured.

SECTION V

APPLICATIONS

GENERAL

The Simpson Volt-Ohm-Milliammeter 270 Series 4 is designed to measure almost all characteristics of electrical and electronic circuits. It is the most versatile piece of test equipment that you can own.

Specific applications in measuring voltage, current and resistance are found in the booklet "1001 Uses for the 260 Volt-Ohm-Milliammeter" which is available at your electronic parts distributor.

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Simpson[®]
INDUSTRIAL
VOM
 model
265

*Featuring single-switch operation
 and both AC and DC current ranges to 12 amps*

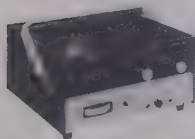
- Measures AC and DC current. Ranges up to 12 amps.
- AC and DC voltage ranges up to 600 volts.
- Four resistance ranges: R x 1, R x 100, R x 1k, R x 10k.
- Rugged, self-shielding taut-band movement is temperature compensated. Assures excellent resolution and repeatability.
- Varistor meter overload protection.
- Separate, isolated AC current ranges let you set up simultaneous AC voltage and current measurement using two pair of leads. Both readings can then be taken by selecting the AC AMPS and the desired AC VOLTS position alternately. The switch position sequence allows you to do this without damaging the meter.
- Adjust-A-View handle doubles as a convenient meter stand.
- A wide selection of accessories are available.

**Unbeatable
portability
and range
coverage!**



the
new

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- Completely portable . . . no separate battery pack or power supply needed. Self-contained battery or line operation.
- Non-blinking 3½-digit display of 26 most used ranges . . . 5 each AC/DC voltages and AC/DC currents . . . 6 resistances . . . with "plus" and "minus" and overrange . . . analog meter readout . . . analog to digital converter uses the dual slope technique.
- A compact, lightweight, multi-use Digital VOM for lab, in-field or general testing .

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- DC Current and Voltage Measurements
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- Automatic Polarity and Out-of-Range Indication
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- Zero Span and Balance Adjustable From Front Panel
- AC Line Operated
- Self-Contained Power Supply
- 10-Day Cyclical Burn-In

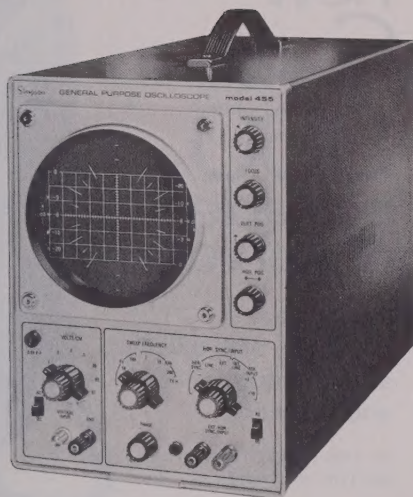
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MODEL 455

GENERAL PURPOSE OSCILLOSCOPE

DC coupled with
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5" CRT measures and
displays waveforms in
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- low parallax, high-contrast graticule
- sensitivity: vertical, 10 mV/cm to 5V/cm; horizontal, 300 mV/cm
- unit accepts scope camera, light hood and vector inputs
- bandwidths: vertical
DC to 10 MHz DC coupled
10 Hz to 10 MHz AC coupled
(-3 dB at high frequency)
horizontal,
DC to 500 kHz DC coupled
2 Hz to 500 kHz AC coupled
- 1 kHz square wave calibration signal provided

high linearity sweep with
automatic sync

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the ultimate in
portability with unique
analog output
and indication

AC LINE OR SELF-CONTAINED
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- **3½ digit, non-blinking, auto-polarity 0.33" LED display**
- 29 popular ranges including "low-power" ohms
- Measures AC and DC current and voltage
- Measures conventional and "low-power" ohmic resistance
- Analog indicator useful for scanning of nulls and peaks
- Analog output signal permits interfacing with chart recorders
- Up-down integration analog/digital conversion assures superior stability, accuracy and noise immunity
- Excellent temperature characteristics and exceptional overrange capability
- Adjust-A-Vue handle
- See detailed specifications and ranges on reverse side
- Solid state IC design provides compactness with high reliability and "low-power" dissipation

Quality is the indispensable component
of every Simpson instrument